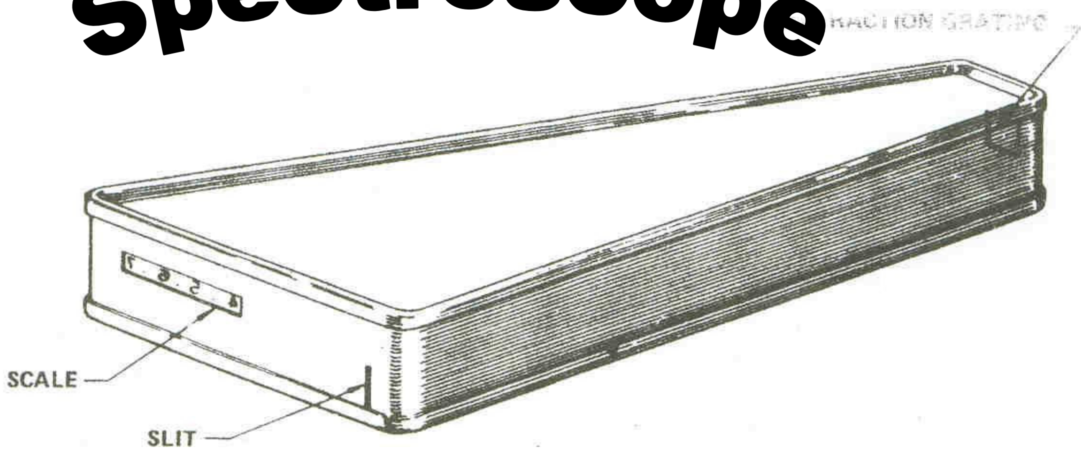
Spectroscope



Take the spectroscope and observe reflected sunlight (You should see no bright or dark lines.), florescent light from the room, hall, and new gym. Identify the emission and absorption spectra using the number scale. Not just the number of the brightest and darkest lines. Identify the element in the lights of the gym and florescent lights. Write a descriptive paragraph of your observations and conclusions. On the graphs at the end of this document, draw the bright lines you see as you observe the different light sources. Use these wavelengths above to determine the main element in the florescent lights in the classroom and the gym. Go on-line and find out how spectroscopes are used in science.

Operation:

Look through the diffraction grating at the narrow end of the spectroscope pointing the slit towards the light source to be analyzed. The spectrum will appear on the right side of the slit below the scale where the wavelengths of the absorption or emission lines can be read. The visibility of the spectrum can be improved by holding the hand around the narrow end of the spectroscope using the thumb and the index finger to keep stray light from around the eye.

Calibration

The numbers on the scale represent 1000 Å units. Looking through the spectroscope at a fluorescent lamp, all colors of the spectrum will be visible with two brighter lines. one violet line at 4360 Å and one green line at 5460 Å. If the lines are not exactly in place, the difference must be added or subtracted respectively in all determinations.

THE STUDY OF THE "FINGERPRINTS" OF LIGHT

When white light is properly analyzed, it appears as a continuous band of colors ranging from violet at one end to red at the other end. Such a band is called a spectrum. A spectrum will be formed when white light passes from one medium into another, and the light is separated into its component wavelengths. The separation of light can be achieved by using a prism or a diffraction grating.

Fundamentally, there are three basic types of spectra:

(1) *Continuous spectrum* - formed when all wavelengths are present. (sunlight)

(2) *Emission (bright line) spectrum* - appearing when a gas is radiating a limited number of wavelengths and thus producing a limited number of bright lines.

(3) *Absorption (dark line) spectrum* - resulting from the absorption of certain wavelengths by a gas, liquid, or other filtering substance located between the radiating source and the observer.

Emission and absorption spectra can be used as "fingerprints" in the identification of the emitting or

absorbing substances because their lines are specific for each element.

As a widely used technique at the frontiers of research, spectroscopy makes use not only of the visible light but of the infrared and ultraviolet radiation as well. Once the student has understood and actually done spectroscope work in the visible spectrum, he will have no difficulty in understanding and using this technique in the full range of electromagnetic radiation in his future research work.

Suggestions for use in the laboratory

Every student in class can experience the excitement of identification of substances by the quality of light as it is absorbed or emitted.

Each element in its gaseous form will emit light of definite wavelengths if subjected to high temperatures or to an electric arc. Strontium, sodium, lithium, and copper salts produce easily recognizable emission spectra if vaporized in a Bunsen burner flame. Helium, oxygen, hydrogen, mercury, neon, etc. are more easily recognized from the electric arc of vacuum tubes.

Elements and compounds may be identified by the light they absorb. Spectroscopic investigation of filters and filter combinations can welt serve as a model for this technique. Observation of the absorption spectrum of a chlorophyll or hemoglobin solution with the QA Spectroscope is an exciting first-hand experience for any student.

It is recommended that students be confronted with the task of identification of substances by their emission or absorption spectra. The teacher may either set up stations or have the students work in groups. The details of the setups of a laboratory investigation will vary with the type of course, whether it be Physics, Chemistry, Biology, Earth Science, or Astronomy.

The following chart lists the wavelengths emitted by some elements:

Element	Wavelengths in Å.
Sodium	5890
Strontium	6060
Lithium	6708
Copper	4300, 6300
Hydrogen (vacuum tube)	6530, 4830, 4310
Mercury (vacuum tube)	4360, 5460, 5770
Helium (vacuum tube)	4470,4680,4920,5010 5870, 6670

The sodium line (5890 Å) may appear as a contaminant in all spectra.

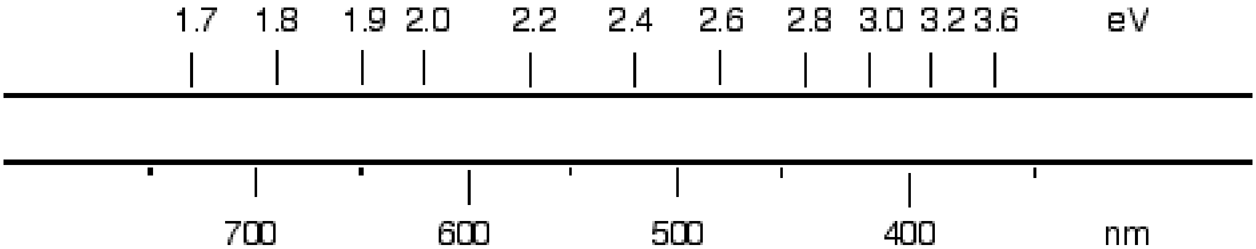
Caution: The following solutions are suggested for producing absorption spectra (each solution absorbs in the spectral range indicated:

Aqueous Copper Sulfate - wavelengths greater than 6450 Å.

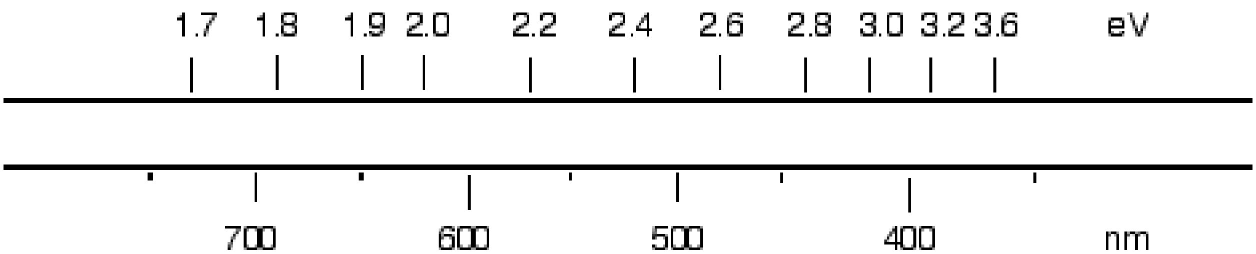
Aqueous Potassium Permanganate - wavelengths between 4550 and 5750 Å.

Spectra Observations

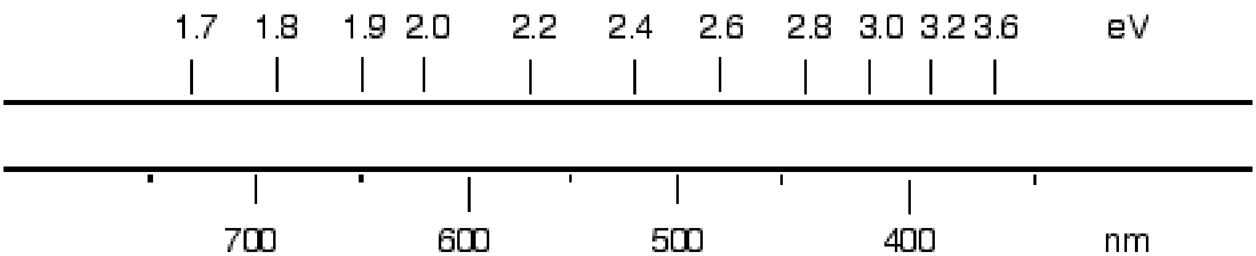
Light source: ____________________ Overall color: ________________



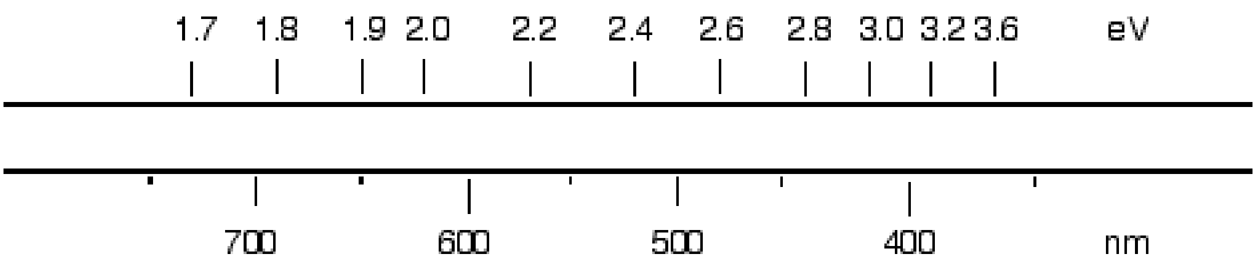
Light source: ____________________ Overall color: ________________



Light source: ____________________ Overall color: ________________



Light source: ____________________ Overall color: ________________



Interpretation & Reflections:

1. Is it possible to accurately determine the spectral composition of a light source by looking at the source with the unaided eye? Why or why not?

2. What's the difference between a discreet and a continuous spectrum? Draw one of each below.

3. Based on your experiences in the lab, what types of materials produce continuous spectra? Discreet Spectra?

Give an example of a light source with:

a. a continuous spectrum

b. a discreet or line spectra

c. both a continuous and a line spectra

2. Describe the spectra produced by an LED (light emitting diode). Does it consist of a single color? If more than 1 color is present is the spectrum continuous or discreet?

3. How well did you predict your results? Can you explain why you were right or wrong in your predictions?

The big question: Based on your observations, what would you say are some things that all light emitting sources have in common? How can they differ?

4. ***Think about plants...***

Question for extra points: Why is the absorption greater in the blue and red wavelengths?